August 2011

Los Alamos National Laboratory Advancing National Security Through Scientific Inquiry

why

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Los Alamos
NATIONAL LABORATORY
EST. 1943

why

About this issue

Preparation, action, experience, and luck combined to keep New Mexico's largest-ever wildfire from consuming any structures or claiming any lives at Los Alamos National Laboratory. The Las Conchas Fire, which began June 26, was a Lab emergency through July 1. Despite the heroics that spared the Laboratory as well as the townsite, the fire's effects throughout the region will be felt by many for years to come in the same way that New Mexicans have lived with the aftermath of Cerro Grande and other infernos.

It's just a coincidence that our cover story concerns the emission of greenhouse gases, which—as they gradually warm our planet—tend to, among other things, increase the likelihood and severity of wildland fires in various parts of the world. "Shedding Light on Greenhouse Gas Emissions" explains what LANL scientists and collaborators are doing to improve humankind's ability to measure and track such emissions. That capability will be essential to the nations of the world as they verify treaties that govern the human-caused output of carbon dioxide and methane.

This being summer, *Why* devotes attention to a few of the many students working at the Lab. Meet them starting on pages 7 and 13.

Thank you for continued feedback about this magazine. We recently conducted a readership survey in an effort to gather even more information about readers' tastes and preferences. As always, we encourage you to let us know what's working—or not—by writing us at why@lanl.gov.

Why *magazine is a quarterly publication primarily for employees and retirees of Los Alamos National Laboratory.*

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interview

Donna Hampton

Human Resources Division Leader

LeRoy N. Sanchez

Hampton came to LANL in March with more than 20 years of human resources management experience, including corporate-level oversight of HR programs at sites managed and operated by B&W Technical Services for the Department of Energy. She has served as vice president of human resources at Y-12 in Oak Ridge, Tennessee, and, most recently, as Human Resources Division manager at the Pantex Plant in Amarillo, Texas.

She has two adult children, Jacquelyn and Gerald, whom she considers her greatest accomplishments.

What drew you to human resources?

When I finished my undergraduate degree in criminal justice at Indiana University, I wanted to go to law school. But I got offered a job right out of school, moved to the East Coast, and decided I would get a master's in industrial relations (working with unions)—and after that I would go to law school. I got my master's from the University of New Haven and was offered a job immediately after graduation.

I worked in labor relations for 10 years before I was offered a position as a human resources supervisor. I just kept getting offers for different positions, all in human resources. I never made it to law school.

Why did you choose to come to Los Alamos?

I saw the posting in a trade magazine and thought, I've worked at Pantex, I've worked at Y-12, which is really good experience—but, the next level in my career could be a Lab environment. I knew it would be so different from a production facility and very interesting as well as gratifying.

During meetings at my previous places of employment, you'd hear people talk about "The Laboratory." At the time I didn't know what they were talking about. Over time I figured it out. When people talked about Sandia, it was "Sandia." When they talked about Livermore they said "Livermore." When they were talking about Los Alamos it was *The Laboratory*. I saw the posting and said, "I want to work for The Laboratory."

What is it about HR that you enjoy?

The diversity of the work; there is never a dull moment when you're dealing with people.

I like the challenge of bringing diverse people, programs, and thoughts together to work toward a common goal.

Most people who work in HR say, "I do it because I love people." It's not that I dislike people; but for me it's more for the challenge of bringing together different types of people to support the organization.

So, you're not a "people person"?

It's funny, when you're in HR you get to do ALL the personality tests in the world, and I am always off the scale in terms of introversion.

I enjoy working with people, but I do prefer the strategy side of it. How can I get all of these people together to figure out what we can do to support the Laboratory? That might be the union negotiator in me.

What do you hope to accomplish in HR?

I believe that in any industry, leadership makes the difference. This is a good time for me to be here because I think I have finally evolved as a leader. I think with good leaders you can accomplish just about anything. Right now in HR, all the right ingredients are here—good resources, good people.

"I like the challenge of bringing diverse people, programs, and thoughts together to work toward a common goal."

LeRoy N. Sanchez

What role does HR play at a science Lab?

Sometimes, it can be hard to figure out the nexus between the mission and what support organizations do. For me, that nexus is very clear. Everything that we do here depends on having the right people in the right jobs to do the research, design, and hands-on work that we need.

HR helps to identify what it takes to recruit those kinds of people as well as what it takes to retain them, to compensate them effectively, and to recognize and reward them.

"Generally, people come here for more than just great benefits—they are excited to do the work."

What are some HR challenges?

In our strategic plan I read a reference to a "creative, curious mind." The biggest challenge is to find people who fit that category.

Generally, people come here for more than just great benefits—they are excited to do the work. In order to retain that talent, we need to figure out what makes Los Alamos different—even unique—and really deliver that message.

How do you feel about the perception that it takes us too long to hire people?

Not to minimize it in any way, but I have never worked any place where people didn't say the hiring process took too long. Because, when you need people, you need them *now*.

We also want the best of the best. We go to great lengths to make sure we have the right person. It takes time. I know the process can be improved, and I work toward that. But I'm not willing to speed it up at the risk of not getting the caliber of person we need to work here at LANL.

That is why it is so important to have those other elements too, making sure that we keep them here—because it is so lengthy. I hear that. I understand it.

If you could offer advice to students when they go on interviews, what would it be?

Flexibility is the key in this economy. We have to be able to do multiple things and have multiple interests.

Then, once you get the position or you're here as a summer student, ask questions, ask questions, ask questions. People love to talk about what they do, and it's such a good learning opportunity.

Does having a new director affect HR in terms of employee relations?

Yes it does. It creates a tremendous opportunity for everybody. As much as most of us don't like change, experience shows that change is good. That is why I'm so glad I am here. It is a great opportunity for me, for all of us. ■

Opportunities for Students Abound on the Hill

by Tatjana Rosev & Steve Sandoval

LeRoy N. Sanchez

From disease modeling to climate change and alternative energy, Los Alamos National Laboratory offers students an opportunity to help solve global problems. Highlighted here are three areas in which students and their mentors are conducting exciting research using state-of-the art computers and modeling programs.

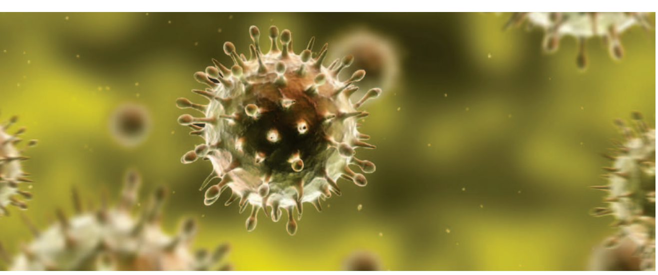
Math student discovers "huge impact" of H1N1 modeling

You can tell a student's had a great time interning at the Laboratory when she keeps coming back, says Sara Del Valle, a mathematician in the Energy and Infrastructure Analysis Group. That's certainly the case with her student Samantha Tracht, who, for the past three summers, has helped Del Valle analyze the impacts of infectious diseases.

"Samantha is great to work with," said Del Valle, who develops and analyzes mathematical models for the spread of infectious diseases. "She's done some really impressive work on H1N1, including how the use of facemasks can help reduce the spread of this disease. In addition, she volunteered at community events and participated in activities organized by LANL Students' Association."

"It's been inspirational working with Sara," said Tracht, a doctoral student studying math at the University of Tennessee at Knoxville. "She's very organized and structured and makes sure that I complete a project every summer. I've even published a paper as an undergraduate. And it's wonderful to have a woman as a role model—there still aren't that many female mathematicians out there."

Tracht noted that she came to Los Alamos through the Department of Energy's Science Undergraduate Laboratory Internships (SULI) program. "When I started looking for summer internships, SULI came up. I applied to Los Alamos because they employ the greatest number of mathematicians, and because Sara's project sounded important—it's really current.



"The 2009 H1N1 outbreak occurred in early March 2009, and when I came on board in June, I was able to help with the mathematical modeling. We compared our data with that of other pandemics, such as the SARS outbreak. We discovered, among other things, that if even 10 percent of the population used face masks during an H1N1 outbreak, it would reduce the cumulative number of H1N1 cases by nearly 20 percent."

Robust mathematical modeling can be a valuable weapon in the fight against infectious diseases, Del Valle said. "Models can have a huge societal impact. Using them, we can simulate plausible scenarios, identify areas where more research is needed, and inform public health policy by developing disease control strategies."

Tracht says she hopes to continue working with Del Valle next year. "I couldn't wish for a better mentor," she said. "Sara's been amazing: she motivated me to apply to grad school, and she's always been there for me with good advice. She's given me what I needed to become a better researcher and a better person."

Climate science: It's all about modeling

When the weather turns warm in Los Alamos, student Peter Revelle returns to the Laboratory's Computational Earth Science group to continue his research on how seasonal snow in the Arctic affects the permafrost there.

Revelle, an environmental science major at New Mexico Institute of Mining and Technology in Socorro, chose Los Alamos "because I know that they do cutting-edge work in many areas, especially those that require high-performance computing using numerical models." Someday, notes Revelle, he hopes to help design such models.

Over the course of a winter, explains Revelle, he's interested in how much snowfall will evaporate and how much remains icy. He also investigates how much of the snow is on hand when spring begins the melts. "Factoring into the overall water budget each of the changes snow undergoes is important," Revelle said. "Part of that is knowing the timing and the depth of the snowfall and how it interacts with the climate of the local environment."

"I couldn't wish for a better mentor."

"I recognize that issues related to climate change are enormously complicated at virtually any scale. They require premier computing resources and expertise in earth and environmental sciences that I know I would have here," he said.

He also lauds his mentor, Bryan Travis of Computational Earth Science. "Bryan has allowed me to seek out and fill in knowledge where I need to in order to accomplish larger goals related to our work. I'm very thankful that Bryan is my mentor."

Harvesting algae to solve global problem

Daniel Kalb knows he's right on the money every time he drives past a gas station. "I see the price of gas go up and up, and I'm glad that I'm part of a team that's developing alternative energy sources," he said.

Together with his mentor, Babs Marrone, and three other researchers in the Bioscience Division's Advanced Measurement Science group, Kalb is looking at various types of algae as sources of biofuel to determine how they can be harvested and what volume of lipids can be extracted from them.

"It's really exciting to be part of the solution to a huge global problem," Kalb said.

The team's project, "Ultrasonic Harvesting and Extraction of Algae," was considered so groundbreaking at its inception last year that it won a 2010 R&D 100 award, Marrone said. Sponsored by *R&D Magazine*, the awards, which recognize the top 100 outstanding technology developments with commercial potential worldwide, are considered the "Oscars of invention."

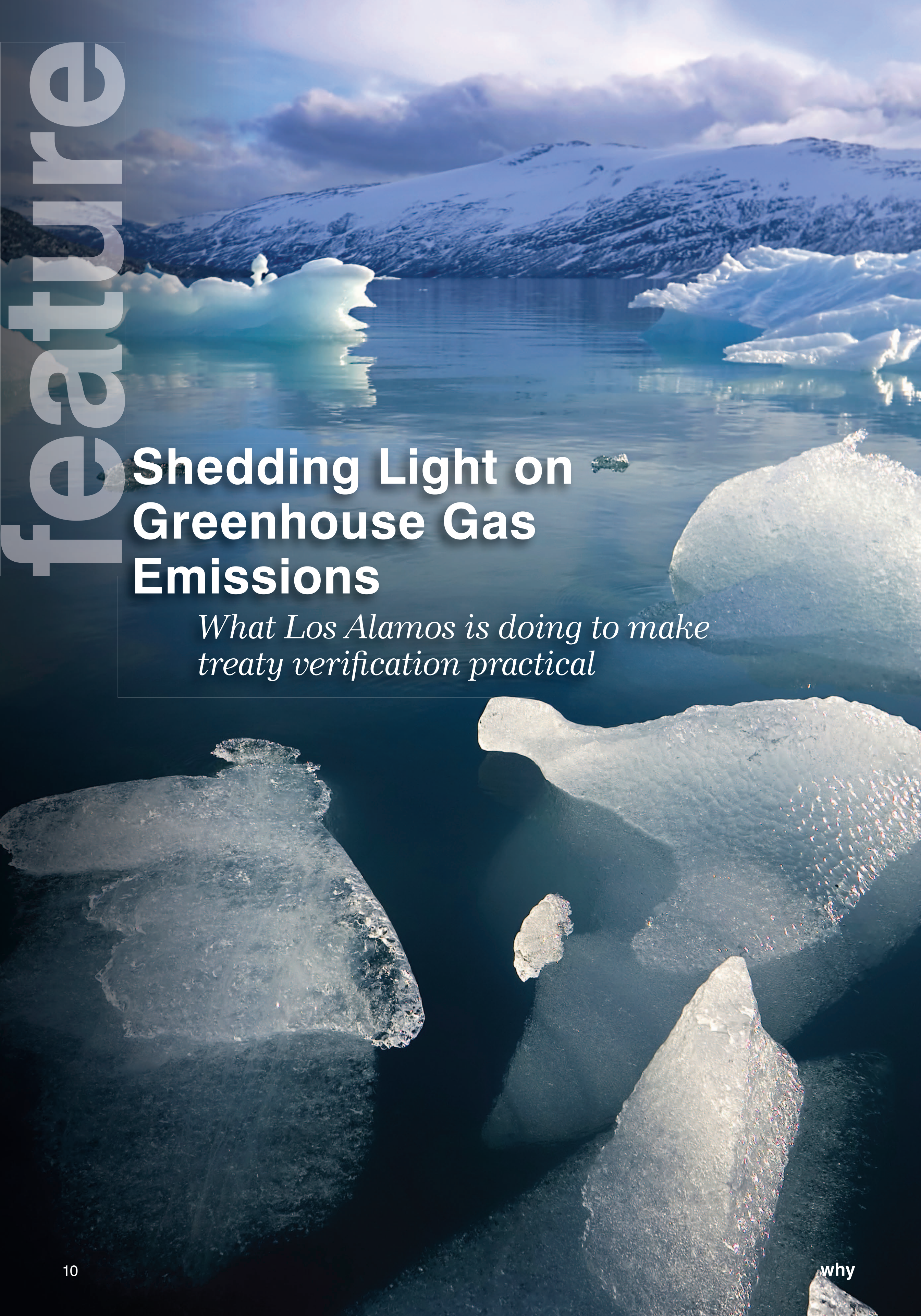
The project leverages the Lab's expertise in flow cytometry, a technique used to examine and count microscopic particles by suspending them in a stream of fluid and passing them by an electronic detection apparatus. The technique "was invented at Los Alamos in the 1960s," Marrone said.

The project is among the contributions that Lab researchers are making as key players in the nation's largest consortium for research and innovation in advanced algal biofuels—the National Alliance for Advanced Biofuels and Bio-Products. The Alliance, funded through the American Reinvestment and Recovery Act as well as by industry and academic partners, is led by José Olivares of the Lab's Applied Energy Program Office. Partners in the Alliance include 3 national laboratories, 17 universities, and 14 industry partners.

Kalb's work is paying off academically: he presented the project at last year's Student Symposium. In addition, he has a couple of academic papers in the works and is developing intellectual property. In July, he and Marrone attended the First International Conference on Algal Biomass, Biofuels and Bioproducts in St. Louis, Missouri.

The young researcher, who first came to Los Alamos in January 2010 with an undergraduate degree in physics from Colgate University, New York, plans to enroll this fall as a graduate student in chemical engineering at the University of New Mexico. Marrone is excited. "I've mentored a lot of students in the 26 years I've been here, and Daniel is easily at the top of that list," Marrone said, "He contributes way beyond his years of education." ■

This summer, about 1,100 students worked at Los Alamos, including 60 high-school students, about 650 undergraduate and 365 graduate students, called *graduate research assistants*. The total doesn't include about 218 affiliate students and 193 guest students.



feature

Shedding Light on Greenhouse Gas Emissions

What Los Alamos is doing to make treaty verification practical

No matter the source, greenhouse gases such as carbon dioxide and methane play a role in the gradual warming of the Earth. They prevent solar radiation from reflecting off the surface of our planet and back into space, and they absorb the Sun's rays and redistribute a portion of them into Earth's lower atmosphere or back to its surface. The result? A slow and steady warming trend that's potentially catastrophic.

While debate rages about who's ultimately responsible for the warming of our world, the international community is beginning to take an interest in the human-generated (anthropogenic) portion of greenhouse gases emitted into the atmosphere. Even if world leaders agree to honor international treaties regulating greenhouse gas emissions, it may prove difficult to accurately monitor gas emissions from individual nations.

The smoke-filled room

Imagine you're transported back to an era when lighting up a cigarette in a restaurant was perfectly acceptable, and that you were a smoker along with a lot of other patrons. The haze in your rustic rathskeller would be a mixture of smoke from cigarettes and cigars puffed by other diners mixed with emissions from the charbroiler, the overheating French fry vat, and tonight's Yankee pot roast special, which has lingered in the oven about 45 minutes too long.

Now imagine, as you exhale deeply and wonder why your blue-plate special hasn't yet appeared, that you wanted to determine what contribution the smoke coming from your mouth was making to the eatery's atmosphere and how it drifts about the room. In the dim light of your subterranean dining hall, your own small contribution of smoke would be difficult to make out, particularly from across the room.

This is why, in the present day, the idea of monitoring greenhouse gas emissions for treaty verification is a complex and difficult problem. Fortunately, Los Alamos National Laboratory, which is accustomed to helping solve some of the world's most difficult puzzles, is working diligently to shed light on greenhouse gas emissions, and in a way that may someday give world leaders confidence in treaty verification.

Future thinking

Manvendra Dubey of the Laboratory's Earth and Environmental Sciences Division has spent years studying global warming from the Arctic all the way to his home state of New Mexico. As the father of a teenager who, along with others of his generation, will someday inherit stewardship of the planet, Dubey feels strongly about the necessity of an international climate treaty.

"If we don't start to get serious about global warming now, we might not have much of a future—my son may not have much of a future," he says. "But in order to have a treaty that everyone will sign on to, we must be able to have the utmost confidence in our treaty verification methods."

That's where Dubey and his interdisciplinary team of colleagues come in. They are working to develop a credible method to accurately measure atmospheric concentrations of greenhouse gases over an area of interest while screening out the huge background of greenhouse gases already in the atmosphere—tracking the metaphorical cigarette plume in the smoke-filled room.

On the ground and in the air

Dubey and colleagues have enlisted the Greenhouse Gases Observing Satellite (GOSAT) as well as New Mexico's Four Corners Power Plant and San Juan Generating Station in an attempt to solve the problem using two different vantage points.

GOSAT is the first satellite with the capable of measuring carbon dioxide and methane in the atmosphere below its orbit. The satellite measures the gases by looking at the reflection of sunlight from Earth's surface and observing changes in the light's wavelength caused by interference with greenhouse gases.

To help calibrate the GOSAT data, the Los Alamos team has set up monitoring stations near Farmington, New Mexico, to observe emissions from the two nearby power plants. Every few minutes, the monitors stare at the Sun to measure how greenhouse gases are affecting the sunlight shining through it. By comparing the spectral data with known data from sensors that monitor emissions from the power plant stacks, the team can gather a catalog of spectral data from a small source calibrated to take into account the large background of existing greenhouse gases in the atmosphere.

"Not only do our ground measurements help validate the GOSAT data, but they also help clarify how greenhouse gases may disperse from a major point source," Dubey said. "It's very easy to put an equation in a model. What's much more difficult is verifying that a model is accurate. This effort could ultimately help us develop modeling and monitoring capabilities that will bridge the credibility gap."

Valuable partnerships

The GOSAT work is being conducted under an agreement with the Japan Aerospace Exploration Agency, which launched the satellite in January 2009. Under the agreement, Los Alamos scientists have access to all

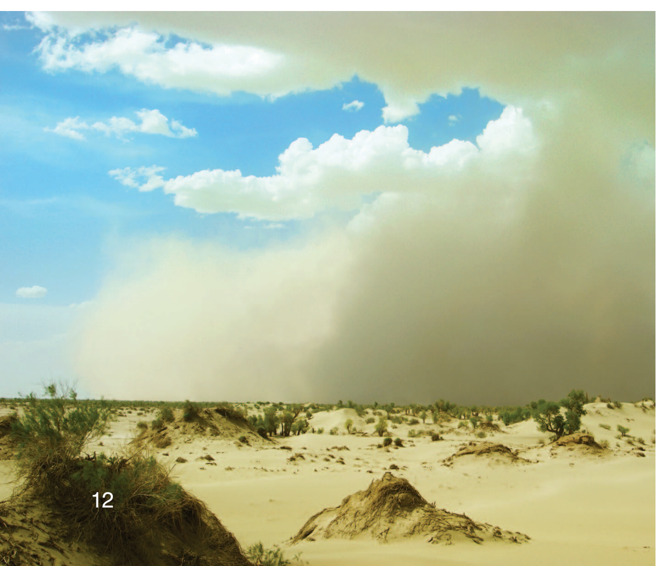
Contractor John Hamelmann assembles components of a small facility used to validate satellite measurements of CO_2 from space.

"If we don't start to get serious about global warming now, we might not have much of a future—my son may not have much of a future."

GOSAT data. They also can request that GOSAT sensors be aimed at specific targets. Los Alamos researchers had the unique honor among Department of Energy national laboratories to be invited by the GOSAT team to help improve the satellite's measurement capabilities and validation protocols.

The power plant initiative has helped forge valuable partnerships with the Public Service Company of New Mexico and the New Mexico Environment Department.

Such collaboration provides invaluable information that could lead to a better understanding of greenhouse gas emissions, a viable approach to monitoring their sources, and a clearer explanation of their migration. ■



Sandra Valdez

Space-Weather Six

A half-dozen grad students came to Los Alamos this summer to learn from experts about solar flares, geomagnetic storms, and more

by Nancy Ambrosiano

For six students working at Los Alamos this summer, the weather was the most compelling thing they thought about. But not weather on the ground, or Weather Underground. It was all about the action out in space.

Los Alamos inaugurated this year its Space Weather Summer School, running from early June through July. It is a joint effort of the Science and Global Security directorates, sponsored by the Laboratory's Institute of Geophysics and Planetary Physics. The school pairs top space science graduate students with internationally recognized researchers at LANL. With the Lab's rich history in space research, from space weather to satellite instruments and planetary exploration, it is a popular destination for space-oriented researchers.

Students in the summer school attend lectures and work on research projects. The projects match the interests of the students with those of their LANL mentors. Subjects range from theoretical studies and data analysis to lab work on instrument development.

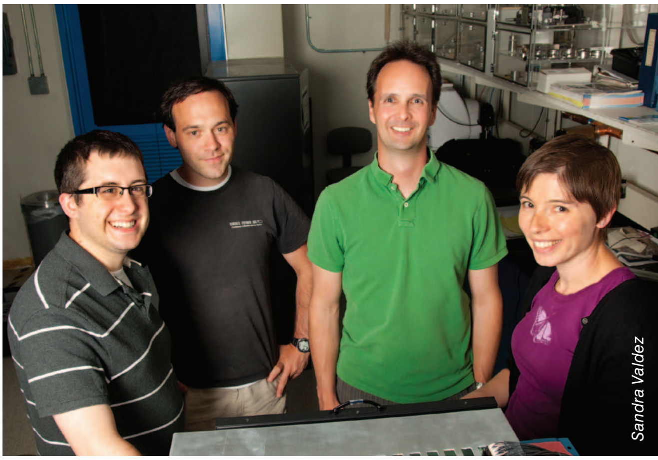
"We felt it was a great opportunity to introduce new students to Los Alamos and also to promote collaborations between our programs and universities," said Josef Koller of International Space and Response Division, who runs the program.

At the end of the session, each student gave a presentation about his or her project and wrote a summary paper that will be published in a LANL compilation.

The students came from all over and were chosen in a highly competitive process, according to Koller. There were three U.S. students (enrolled at Dartmouth College, West Virginia University, and University of New Hampshire), two students from China enrolled at Rice University and University of Southern California, and one from South Korea enrolled at University of Alaska at Fairbanks.

Their early impressions of Los Alamos were less than surprising.

"It's definitely a change from academia. It's pretty quiet, but I like it so far," said Alex Boyd, a University of New Hampshire student. He heard about the program from his advisor at UNH, and, upon winning a placement in the program, decided to study new materials for radiation detection. "I wanted to experience the other side of it," he said, referring to the fact that his academic work had been focused more on computer modeling. The hands-on approach agrees with him, said Boyd, who works with mentors Russell Terry and Laura Stonehill.



Students Alex Boyd and Justin Elfritz with program lead Josef Koller and mentor Laura Stonehill.

Liheng Zheng, a physics doctoral candidate from China studying at Rice University, said, "It is interesting to see that some of the Laboratory buildings are not exactly high-tech looking, but at the same time there are so many important things happening inside."

Classmate Miles Engel of Dartmouth agreed, but then moderated the comment, noting that government installations around the country tend to focus on the essential work and less on the aesthetics. With mentor Brian Larsen, Engel is studying solar energetic particles—"just the protons," he said, "since they have a large effect on satellites."

"It's definitely a change from academia. It's pretty quiet, but I like it so far."

Zheng was impressed, however, by how the atmosphere of the Laboratory differs from that of a college campus. "This entire Laboratory is very hard-working. I guess the town does not have as much fun as a city, with distractions, so you can focus more on your research." Zheng is working on a friction-code model for the Earth's magnetic equilibrium, under the guidance of Sorin Zaharia. Perhaps it's just as well that there are fewer distractions.

From South Korea, by way of Fairbanks, is Sun Hee Lee, who worked with mentor Steve Morely to understand the relationship between solar substorms and electromagnetic ion-cyclotron (EMIC) instability waves. She so far had only ventured as far as the Bradbury Science Museum in her local explorations, but opined that the best things there were the Fat Man and Little Boy replicas.

The California student, Ouliang Chang, is a USC doctoral candidate originally from China who is collaborating with Peter Gary to create the first large-scale, three-dimensional simulation of a particular type of turbulence in the solar wind. When Chang first came to Los Alamos, he had hopes of playing a pickup basketball game at Urban Park, but realized that, with the altitude change, he'd be a less-daunting player than usual.

Chang's altitude experience matched that of Justin Elfritz, of West Virginia University, who found his cycling stamina reduced by lack of oxygen, but was cheerful about the whole adventure. Elfritz is developing sensitivity analyses for L* (pronounced *L-star*) radiation belt electrons, aiming to compute the L* quantities faster and more economically. L* is the magnetic drift invariant used for modeling radiation belt dynamics and for other space weather applications. His mentor is Jon Niehof.

When freed from their laboratory and computational labors, the students took an outing to Trinity Site, attended a conference in Santa Fe, and enjoyed a barbeque or two, according to Koller. Then it was back to the grindstone. ■

What's space weather?

"Space weather" refers to conditions on the Sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can influence the performance and reliability of spaceborne and ground-based technological systems and can endanger human life or health.

Solar wind: *stream of charged particles ejected from the Sun's outer atmosphere.*

Magnetosphere*: the area of interaction between a stream of charged particles (the solar wind, for example) and the magnetic field of a planet.*

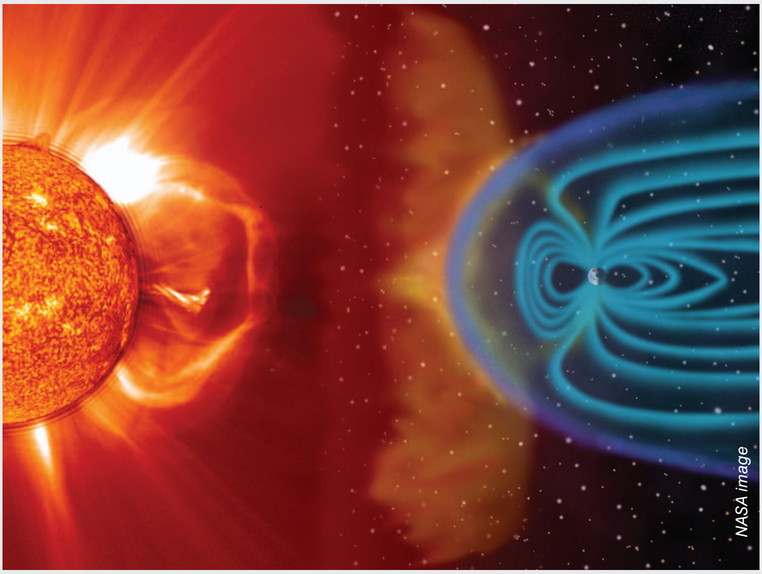
Ionosphere: *part of the upper atmosphere (inner edge of the magnetosphere), ionized by solar radiation.*

Thermosphere: *The largest of several layers that comprise Earth's atmosphere. Except for the exosphere, it's the most distant from Earth's surface.*

What you learn if you're a space-weather school student at LANL (and from whom):

- *Plasma waves and instabilities (Peter Gary)*
- *Magnetospheric overview (Geoff Reeves)*
- *Spacecraft environment and charging (Joe Borovsky)*
- *Magnetospheric storms (Vania Jordanova)*
- *Plasma sheets and substorms (Sorin Zaharia)*
- *Space data and pitfalls (Reiner Friedel)*
- *Particle transport and adiabatic conversion (Mike Henderson)*
- *Ionospheric outflow (Dan Welling)*
- *Orbital dynamics (Thomas Alan Lovell, Air Force Research Laboratory)*
- *Data assimilation (Humberto Godinez)*
- *Statistics for space science (Steve Morley)*
- Python *programming for space science (Jon Niehof)*

Related link: http://SpaceWeatherSchool.org


NASA image

Sandra Valdez

More Than Just a Waste Dump

A collaboration between the Environmental Programs Directorate and the Earth and Environmental Sciences and Chemistry Divisions likely will yield valuable information about the environmental behavior of plutonium

by Patti Jones

The excavation of the Lab's oldest waste disposal site is fertile ground for researchers interested in how plutonium ages and migrates in the environment.

"We're trying to add to the body of knowledge," said Robert Roback of Earth and Environmental Sciences. "In most places, plutonium is difficult to study because concentrations are not high enough to study how it travels through the ground when it is buried."

Plutonium is a significant contaminant at many Department of Energy sites, Roback said, and environmental releases of plutonium cost the nation billions of dollars in remediation and compromised land and water resources. In addition, plutonium contamination also raises the ire of public interest groups and government agencies.

Places to study plutonium in the environment are limited, due partly to its relatively young age and to a lack of locations where the sample concentrations are large enough to provide accurate data.

"In most places we find it, it's difficult to study the source and the material that migrates from the source," Roback said. "Being able to see it in a real setting and at concentrations high enough to study migration could yield a lot of valuable information."

That's why the Lab's Technical Area 21 (TA-21) may serve as a valuable natural research laboratory. In addition to Material Disposal Area B (MDA-B), which was used from 1944 to 1948 and is the Lab's oldest waste disposal site, two other waste disposal sites at TA-21—MDA-A and MDA-T—offer rich opportunities for scientific information.

"As the oldest plutonium sites in the world, they are great natural labs and are in our backyard," Roback said. "We have the laboratories, the experts, the instrumentation, and the need to study it. Plutonium has only been around for about 70 years, and we're trying to predict its behavior for thousands of years."

When a highly radioactive piece of pipe was unearthed at MDA-B last summer, Roback's team obtained a sample of the surrounding soil and analyzed it using facilities at Stanford University and the University of Nevada, Las Vegas.

Mitch Goldberg and Robert Roback at Technical Area 21.

Enclosures over the excavation site at Technical Area 21.

"We've learned many things from that initial sample," Roback said. "We determined that plutonium was present in different molecular forms, the expected Pu-oxide form and a form we had not seen before. Just how these different forms behave in the environment is an important scientific question." Roback applied for Laboratory Directed Research and Development (LDRD) funding to further analyze the MDA-B sample and hopes to do the same to study aging and migration at MDA-A and MDA-T. Although this proposal was unfunded, Roback plans to try again next year.

"Plutonium has only been around for about 70 years, and we're trying to predict its behavior for thousands of years."

Remediation efforts at TA-21

General Leslie Groves unwittingly created a future "natural laboratory" when he stored waste in two tanks—called the General's Tanks—that were buried at MDA-A in 1945. Each tank contains about 3,000 gallons of sludge and fluid. (See "Piercing the Darkness" in the January 2011 issue of *Why*.)

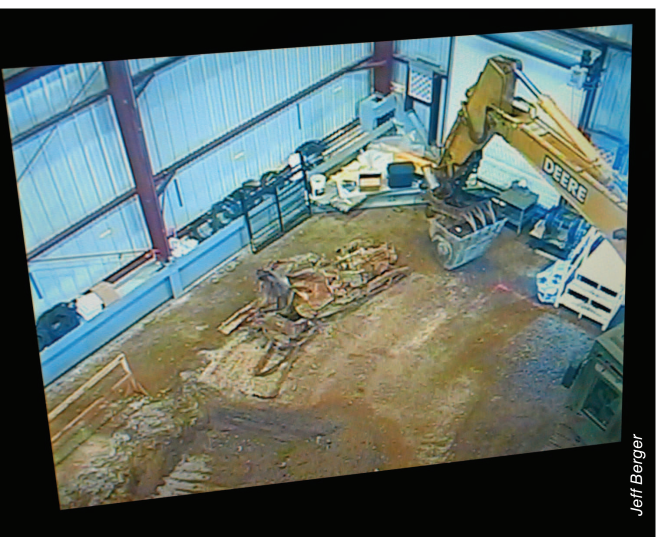
As part of the environmental remediation at TA-21, the fluids were sampled in March 2011 and the tanks are to be removed next year. Roback's team will provide valuable characterization data that will be used to help guide remediation efforts.

"MDA-A presents a great opportunity for forensic studies," Roback said. "We can look at the effects of aging since 1945."

MDA-T contains four large absorption beds and about 64 waste disposal shafts. The shafts contain americium, plutonium, uranium, and other waste streams. Crews used cement to solidify them prior to disposal. Workers then capped the shafts with concrete and covered them with several feet of soil.

"MDA-T has the best possibilities to study migration," Roback said. "The concrete waste forms have been in the ground for more than 40 years. MDA-T provides a unique opportunity to study the stability of concrete waste forms under environmental conditions."

Robert Roback stands in front of an excavated trench at Materal Disposal Area B.



Excavation inside the enclosures is monitored via closed-circuit television.

Compiling a body of scientific knowledge about the migration potential of plutonium and other actinides like americium has practical applications for future environmental remediation. In fact, the collaboration between Environmental Programs and Roback's research team may affect the future direction of these remediation efforts.

"In addition to providing a scientific basis and long-term predictive capability, hopefully the science we provide can help make environmental remediation cheaper, faster, and safer," Roback said. ■

94 Pu Plutonium [244]	

Plutonium (Pu) *is a radioactive element first synthesized in 1940 at the University of California, Berkeley. The team was led by Glenn Seaborg, who would go on to win the Nobel Prize in Chemistry and for whom Los Alamos National Laboratory's Seaborg Institute is named.*

By July 1945, LANL scientists involved in the top-secret Manhattan Project had learned enough about plutonium to create the world's first Pu atomic bomb, named Fat Man. In August, the bomb was used to end World War II.

Plutonium is one of the most complex elements in the periodic table. Under pressure, the metal exhibits six crystalline forms. When subjected to changes in temperature, pressure, chemical additions, and the passage of time, crystalline plutonium is notoriously unstable. Plutonium is highly reactive in air, and its continuous radioactive decay causes self-irradiation damage.

Fallout from nuclear weapons testing during the 1950s and 1960s left very low concentrations of plutonium in soils. More than 2,200 metric tons of plutonium exist throughout the world in the form of spent nuclear fuel, nuclear weapons components, legacy materials, and wastes. This number grows every year through production in nuclear reactors. These large inventories must be managed by a highly trained workforce skilled in safe-handling practices.

The type of plutonium used in nuclear weapons emits alpha radiation as it decays. Alpha radiation cannot penetrate the skin, so it poses little risk to human health from external sources. Internal exposure to plutonium by inhalation or ingestion, however, is a serious health hazard. Project teams take every precaution when working with plutonium residuals, including safety gear, excavation enclosures, air-monitoring equipment, and HEPA filters.

Though the most common plutonium isotopes are used in the production of electricity, others are used to power satellites and pacemakers. As a heat source, plutonium has flown on many NASA missions, including the New Horizons spacecraft on its way to rendezvous with Pluto and its moons in July 2015.

Scientist Luis Alvarez (right) and a military policeman pose with a box containing the plutonium core of Fat Man, the bomb used in the attack on Nagasaki, Japan (circa 1945). Alvarez would later win the 1968 Nobel Prize in Physics.

What do you do?

Jobs around the Lab

by Jennifer Awe

Dave Keller is a biologist with Environmental Stewardship. He conducts monitoring surveys of federally protected birds—like the Mexican spotted owl, bald eagle, and the southwestern willow flycatcher—and with the other biologists reviews all Lab projects to determine if they could negatively affect federally protected wildlife.

What special training did you receive to work with bird populations?

I received my biology degree from the University of New Mexico and did a lot of bird work in college. I've moved around quite a bit because bird research is seasonal. Before joining the Lab in 1993, I spent six months in Antarctica, where I studied sea birds.

What traits should every biologist have?

You should really enjoy being outdoors. Sometimes we are out before dawn so you'll need to be flexible with your schedule. Stamina helps when you need to hike through remote areas, carrying lots of equipment. Obviously you need to be very comfortable with and respectful of the wildlife and all the critters you'll meet.

Why did you choose this field?

I was originally in medical biology but realized that I liked working with animals more than people.

What's the best part of your job?

Discovering all the wildlife here at the Lab—like bears, elk, deer, mountain lions, and birds—and seeing habitats from their perspective. LANL is basically a wildlife preserve, with more than half of the Lab property restricted and undeveloped.

What's the most challenging part?

When working around so many different project schedules and timelines you have to be flexible.

If you observe a potential impact to wildlife, what do you do?

We make suggestions for changing the location or timing of a project to lessen impact. It could mean, for example, postponing work awhile to avoid sensitive breeding seasons. Typically, people are very willing to work around habitats and coexist.

For large projects, we draft a biological assessment and work closely with the federal Fish and Wildlife Service to obtain approval before moving forward. In addition, we work with our other neighbors such as the National Park Service, Forest Service, and New Mexico Game and Fish to determine if a non-threatened species should have special consideration.

What do you do on your days off?

Sometimes I go for a hike or—believe it or not—bird watch, but other times after hiking all week it's nice to just go to dinner or see a movie.

Do you have any stories of animal encounters?

I've encountered bears and mountain lions. Once while I was netting bats, a curious bear came right up to see what we were doing. He took it all in, realized we didn't have any food, and walked off.

What's your favorite animal to work with?

Ravens. They're very difficult to catch because they are so smart. They try to out think you and it's almost like they taunt you.

Biologist Dave Keller spends his time tracking and monitoring birds on Lab property.

Arlene Martinez works in the mailroom and delivers to more than 60 stops on her daily route.

Arlene Martinez works in the mailroom. Her team processes between 30,000 and 50,000 pieces of mail every day and delivers to more than 600 mailstops around the Laboratory.

How long have you been at the Lab?

I started as a contractor and worked in custodial services, then I was lucky enough to be hired on in the mailroom in 1991, and I've been here ever since.

When I was hired, I didn't know anything about a mailroom and I've learned so much over the years. I love it.

What do you love about it?

I get to see all areas of the Lab and I don't have to sit at a desk all day. I walk a lot and meet a lot of new people. This is a great team to work with.

I always wanted to work in a mailroom. I remember going to the post office and thinking that the people there had great jobs.

What is your typical day?

The mail is delivered to us early in the morning, and then I go through and track the inventory. We sort mail into routes and then band, pack, and head out to deliver the mail to its location.

Once we get back, we go through and sort all the mail we've picked up that morning. I also pick up all our A1000 recycling materials along my route—like binders and printer cartridges.

What traits are needed to do your job?

You have to be alert and very safety conscious. We're in customer service, so it's important to enjoy helping people. I get along with everyone I meet and do the very best job I can.

What interesting items have you seen?

We see everything from holiday cards to letters from prisons. One time we heard a ticking sound coming from a package. We immediately contacted Emergency Management & Response. It turned out to be a pager that was never turned off!

What safety precautions changed after 9/11?

We are always safe here and double check everything, but after 9/11 and the anthrax scare I was a bit scared. All of our training in suspicious packages, foreign labels, and what to look for really helps by making me feel aware and prepared to do my job safely.

What do you want people to know about your job?

I want people to know that we're here to help. It's also important that people label their mail correctly.

What do you do when you're not working?

I love to go camping in the summer. I also do a lot of bead work, mostly making bracelets.

Spending time with my family is important to me, including my twin sister who also works here at the Lab. We commute together every day from Española. ■

observer

Fire on the Hill

AP photo/Jae C. Hong

Steve Wells, Los Alamos National Bank

AP photo/Craig Fritz

AP photo/Jae C. Hong

Joseph Johnson/LANL

Tales of the Las Conchas wildfire—the largest in New Mexico history—will be told for years to come. Parts of the story, images captured by neighbors, photojournalists, and emergency personnel, appear on these pages: from the dedicated first responders working to save property, lives, and habitat to Lab employees, evacuees, and volunteers—even a single charred leaf that landed 25 miles away.

Please share your story with us by e-mailing why@lanl.gov with the subject line My Las Conchas Story.

Jayson Coil

AP photo/Jae C. Hong

AP photo/Jae C. Hong

Jayson Coil

Matt Locke

AP photo/Jae C. Hong

AP photo/Santa Fe New Mexican, Jane Phillips

Kristen Honig/US Forest Service

Douglas Wedman

James Rickman/LANL


Mike Spieth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AP photo/Susan Montoya Bryan

Kari Greer/US Forest Service

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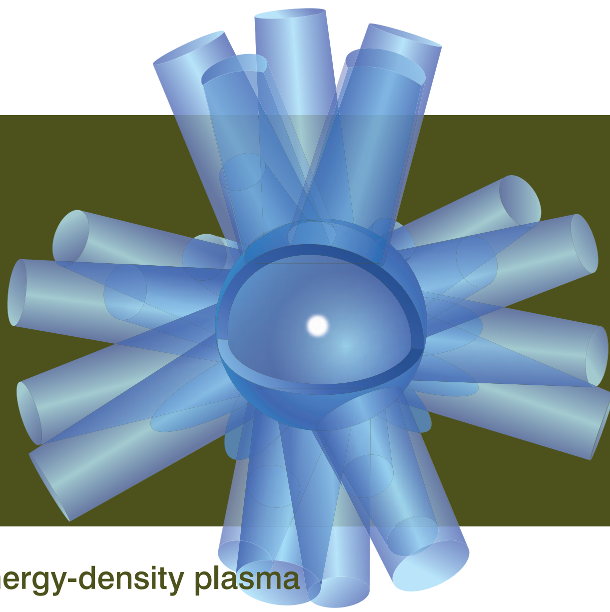

Studying the fundamentals of high-energy-density plasma

In order to create matter with pressures that equal or exceed the strength of materials, it's necessary to concentrate a lot of energy into a small volume.

One reason to create such high-pressure matter is to study its properties in a controlled laboratory setting. This illustration shows part of an experiment that allows scientists from the Lab's Plasma Physics Group (in collaboration with HyperV Technologies Corp., University of New Mexico, and University of Alabama, Huntsville) to study the fundamental properties of high-energy-density plasmas, while also exploring a unique approach to controlled fusion—a green and limitless energy source.

The experiment uses high-speed plasma jets—accelerated to 50 kilometers (31 miles) per second—to form an imploding spherical shell that collapses and reaches very high pressure.

With enough initial energy, this collapsed plasma may reach conditions that enable nuclei of the same electrical charge to overcome a strong repelling force and join together (fuse). The ultimate goal is to generate more electrical energy via fusion than was required to start the reaction.

Computer simulations predict how much initial energy is needed to reach pressures exceeding the material strength of solid matter. The experiments will show whether the computer models are correct, and whether it is feasible to try more energetic versions of this approach for fusion energy.